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ABSTRACT

This booklet was written for anyone interested in growing mosquitoes and experimenting with them. There are three major sections: (1) rationale for studying mosquitoes, (2) raising mosquitoes, and (3) some scientific findings. The first section describes basic information about mosquitoes. The second section includes information about materials, hatching eggs, mosquito larvae and pupae, adult mosquitoes, and the complete life cycle of mosquitoes. Scientific findings include information on mosquitoes and sound, biting, mosquito flight, and different types of mosquitoes and the diseases they spread. (DS)

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Mosquitoes

A Resource Book for the Classroom

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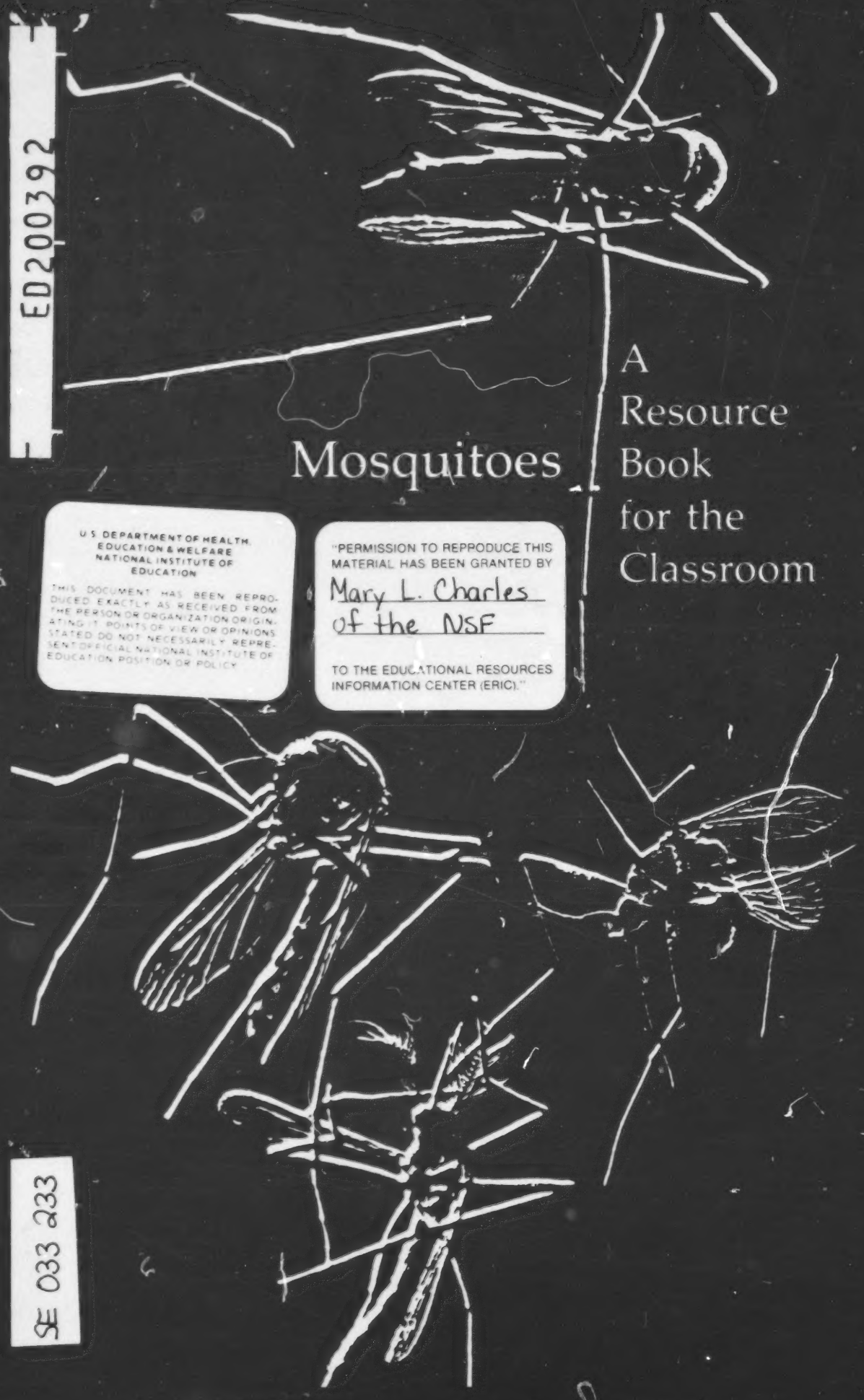

SE 033 233

Mosquitoes
A Resource Book for the Classroom

Elementary Science Study

WEBSTER DIVISION, McGRAW-HILL BOOK COMPANY
New York • St. Louis • San Francisco • Dallas • London • Sydney • Toronto

The Mosquitoes Unit
Mosquitoes: A Resource Book for the Classroom

Related Units
Pond Water
Butterflies
Behavior of Mealworms
Earthworms

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Preface

The Elementary Science Study is one of many curriculum development programs in the fields of science, social studies, and mathematics under preparation at Education Development Center, Inc. EDC (a private non-profit organization, incorporating the Institute for Educational Innovation and Educational Services Incorporated) began in 1958 to develop new ideas and methods for improving the content and process of education.

ESS has been supported primarily by grants from the National Science Foundation. Development of materials for teaching science from kindergarten through eighth grade started on a small scale in 1960. The work of the project has since involved more than a hundred educators in the conception and design of its units of study. Among the staff have been scientists, engineers, mathematicians, and teachers experienced in working with students of all ages from kindergarten through college.

Equipment, films, and printed materials are produced with the help of staff specialists, as well as of the film and photography studios, the design laboratory, and the production shops of EDC. At every stage of development, ideas and materials are taken into actual classrooms, where children help shape the form and content of each unit before it is released to schools everywhere.

Acknowledgments

David Webster started this unit after Thomas Eisner of Cornell University suggested that mosquitoes would be good organisms for children to work with. Webster wrote a student booklet and a teacher's guide which were used in several classes. Difficulty in obtaining *Aedes* eggs delayed further work on the unit until Eugene Gerberg, of Insect Control and Research, Inc., was able to supply them.

This booklet incorporates Webster's material and Gerberg's information on husbandry, as well as new questions and experiments which grew out of work done at ESS by Robert Stinson and myself. The guide was used in about twenty trial classes in the spring of 1968 and has been revised on the basis of that experience.

Most of the background information for this booklet came primarily from *The Natural History of Mosquitoes*, by Marston Bates, and *Aedes Aegypti*, by Sir Richard Christopher.

Mary S. Gillmor

This booklet has been written for anyone who would like to try growing mosquitoes and experimenting with them. Older children (fifth grade and above) can use it by themselves. Younger children will need the direction of the teacher. The *Guide* contains information on raising mosquitoes, some ideas for experiments to try, and descriptions of some interesting experiments that scientists have performed on mosquitoes.

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Why Study Mosquitoes?

Mosquitoes are common in most parts of the world. In temperate climates they seem to appear suddenly when the weather turns hot. Where do they come from? What do young mosquitoes look like? Do all mosquitoes bite? By raising mosquitoes, you can find out some of the answers to these questions.

Mosquito eggs are laid on a damp surface, near water or on the surface of water itself. When water rises and covers or wets them, they hatch into larvae, which breathe air but live in the water. After a few weeks, they change into pupae, which float in the water until the adult mosquitoes emerge to fly in the air. The complete life cycle usually takes six to eight weeks. Little space is needed—the larvae and pupae will live in a pint jar, while the adults can easily be confined in a small cardboard box-cage. (It's not hard to keep the mosquitoes in the cage, so you needn't worry about mosquitoes flying around the room!) In addition, many interesting experiments can be performed on the larvae.

Raising Mosquitoes

Materials

TO RAISE MOSQUITOES, YOU WILL NEED–

- mosquito eggs (See page 3.)
- dog biscuit or yeast
- glass jar with a tight cover
- clear-sided waterproof container which can hold at least a cupful of water (A peanut butter jar is good.)
- cage (See page 14.)
- absorbent cotton
- sugar
- paper toweling
- eyedropper
- plastic spoon

FOR THE SUGGESTED EXPERIMENTS ON MOSQUITOES, YOU SHOULD HAVE–

- magnifying glass
- clear plastic or glass tube or test tube (about ⅜" diameter)
- corks or stoppers to fit the ends of the tube or test tube
- source of light (flashlight or lamp)
- tuning forks (Perhaps you can borrow them.)
- ice
- candle
- transparent or translucent plastic straws
- modeling clay
- materials for an aspirator (See page 15.)

Eggs

There are many different kinds of mosquitoes. The kind that has been easiest to raise in classrooms is *Aedes atropalpus* (the rock-hole mosquito). *Culex* mosquitoes have also been raised successfully, but the eggs are more fragile. The simplest way to start raising mosquitoes is to order some eggs from a biological supply company.

Aedes atropalpus eggs can be ordered from –
Insect Control and Research, Inc.
1111 North Rolling Road
Baltimore, Maryland 21228

Aedes mosquitoes lay their eggs singly on a damp surface. The eggs look like tiny separate black specks. The cost is about $10 for about 200 eggs. (This includes a rearing container and a cage for mosquitoes.) They are shipped in a small plastic vial containing a piece of paper toweling on which the eggs were laid. One vial should produce enough larvae for 15 students to work with. Most of the eggs should remain alive in the closed vial for at least two weeks if kept at room temperature.

Culex eggs can be ordered from –
Carolina Biological Supply Company
Burlington, North Carolina 27215

Culex mosquitoes lay eggs which are stuck together. These float on the water and are called egg rafts. A *Culex* egg raft looks like a small cluster of black dots. The cost is approximately $3.50 for each egg raft containing about 100 eggs – enough for 10 to 15 students. *Culex* eggs may hatch in shipment, so the package should be examined immediately on arrival. Look very carefully at the packing material before you throw it away. Put the packing material itself in some water to see if any larvae (little "worms") wriggle out.

If you cannot get eggs from a supply company, perhaps you can find some yourself. The black-speck eggs of *Aedes* mosquitoes are usually laid on a damp surface, such as a leaf or twig, just above the water. Sometimes the water and the eggs dry up, but the eggs do not die. They will hatch when they become wet again.

Mosquitoes lay their eggs in almost any water. Some lay eggs in lakes, streams, marshes, and mud puddles. Others use rainwater which collects in tree holes, flowers, fallen leaves, broken nuts, hoofprints, animal

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skulls, rock holes, seashells, crab holes, tin cans, and jars. Since mosquito eggs are very small, you may not be able to find any outdoors, but you can try looking for black specks on sticks and leaves just above or on the surface of any still water in spring and summer. You will be able to look for eggs more carefully if you collect these sticks and leaves and bring them back to your school or home for study. You also might try putting leaves and sticks from the edge of a pond in water to see if anything hatches out.

If you don't find eggs, you may be able to get larvae from a nearby pond. Scoop up water from along the edge. Look for tiny wiggling "worms." A net made out of a coat hanger and an old nylon stocking may be useful. You will probably find other interesting animals, as well. (See the Elementary Science Study unit POND WATER.)* Remember that young mosquito larvae are barely bigger than the eggs they hatched from. Look carefully and use a hand lens.

Hatching To get your eggs to hatch, you must put them in water. Tap water is usually safe for mosquitoes if it has been boiled or allowed to stand overnight in an open container so that chlorine and other chemicals that may have been added can evaporate. (These chemicals make the water safe for people but may be harmful to mosquitoes.) To be on the safe side, you can use rainwater, clean melted snow, or pond or stream water strained through a paper towel.

Mosquito eggs hatch better when there is very little air in the water. One way to drive much of the air out of water is to fill a jar half-full of water, place it in a pan of water on the stove, and bring the water to a boil. Then quickly seal the jar and let it cool. Adding a bit of food to the water may help the eggs to hatch, too. A tiny crumb of crushed dog biscuit is enough for a pint of water.

When the water has cooled to room temperature, add the eggs. If they were laid on paper or on a stick, put this right in the water. Do not attempt to scrape off the eggs. Now watch: your mosquitoes may hatch in as little as 15 minutes. Some eggs take several days to hatch, however, so keep watching whenever you have a chance, even if nothing happens right away. Leave the jar uncovered.

*Available from Webster Division, McGraw-Hill Book Company, Manchester Road, Manchester, Missouri 63011.

Mosquito Larvae

You may be quite surprised to see what hatches out of the black specks that are mosquito eggs. Mosquito larvae, sometimes called wrigglers, don't look like mosquitoes at all. Look at them closely with a magnifying glass. Draw some pictures of them.

Which end is the head? Can you find any eyes?
Does a wriggler have legs?
How do they move? Do they ever move without wriggling?
How big are they when they first hatch?
Do you notice that your wrigglers have grown after a few days?

You have probably seen your larvae going up and down in the water. How often does one do this? Do you think a larva could find its way to the top if

the water was very deep? How long will a larva stay at the top of the water if it isn't disturbed?

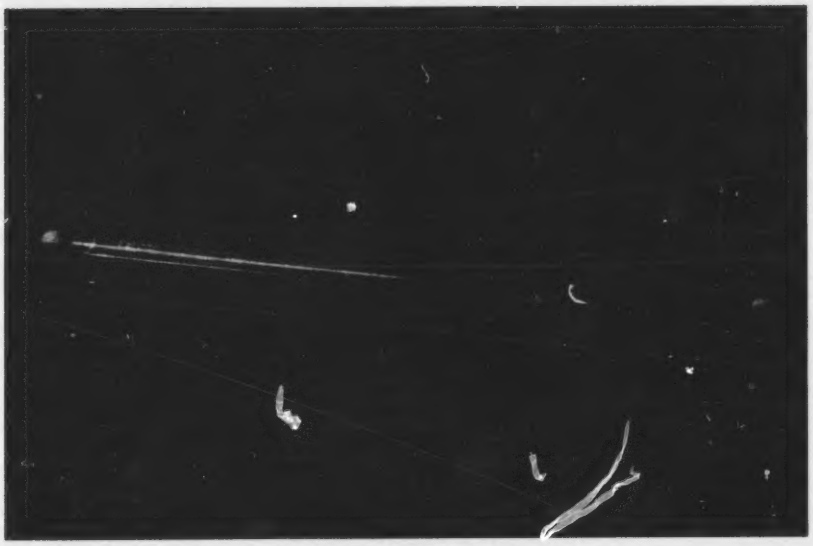
Can you guess why the larvae go to the top of the water? Put one or two larvae in a container with water. Put a piece of fine screening in the water just below the surface so that the larvae can no longer get to the top. What happens to them? How soon?

You may find scum on the surface of the water someday. If it is very thick, it can act like a piece of screening. Why do you suppose oil is sometimes put on water in swamps?

What happens when you tap the top of your container? Do the larvae go *up* when you tap the *bottom* of the container? How do they react to a bright light or a sudden shadow? Why do you suppose they do this?

One way to find out more about how the larvae behave is to put a few larvae in a long clear tube filled with water and seal it with a cork at each end. Do the larvae always go down when you shine a light on them? If you move the light to the bottom, will they go up? How do they react if you cool the tube in ice or heat it on the radiator?

If you put the larvae and some water in a clear plastic straw, you may be able to get the water to stay in and leave an air space at both ends, even with the straw placed horizontally. Try the straw in several positions. Do the larvae use the air pockets beside the water, or do they only head for air spaces that are *above* the surface of the water?



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Food for Larvae Put a tiny bit of crushed dog biscuit or yeast (the size of the head of a pin) in the water every two or three days, and be sure to add more water as it evaporates. If a scum forms on the water, clean it off with a paper towel and add less food next time.

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Very tiny living things, so small that you need a microscope to see them, feed on the dog biscuit, and the larvae eat these things. The dog food is put into the water to help these living things—bacteria, yeasts, and protozoa—grow and reproduce. Can you find out whether a mosquito larva can live in water without any food? Can you slow down the growth of a larva by feeding it less?

If you look very closely at the head of a mosquito larva with a hand lens, you should be able to see how it gets its food. Watch the motion of the water as the larva's feeding brushes swirl it around. The brushes act like little propellers and cause the larva to move around slowly under the surface of the water. The brushes also make water move toward the larva's head. The swirling water carries solid stuff into its mouth. In the larva's throat are hairs which trap the pieces of food. The larva spits the water back out and swallows the food.

Molting Occasionally you may find things that look like dead larvae in your container. Look at them carefully. Count your larvae. Did one die or are you looking at a shed skin?

As a larva grows, it sheds its skin four times (this is called molting). It does this because the shell or skin which covers the larva cannot stretch. When the larva becomes too big, it splits its old skin and wriggles out of it. The new skin underneath is wrinkled. It unfolds so that the larva has more room. Do you know why you don't have to shed your skin as you grow bigger?

How long does a larva keep the same skin? To find out, you might put one larva by itself in a container of water.

Does a larva grow faster if it is in a warm place? Take two larvae about the same size, and put one in a jar in a warm place and one in a jar in the refrigerator. Which grows faster?

The Wriggler's Enemies Wrigglers often live in ponds. Perhaps you can find some in a pond near you. Many other animals are in the pond. Some of them eat wrigglers. Some of the wriggler's enemies are leeches, snails, crayfish, water bugs, fish, tadpoles, turtles, ducks, and shore birds. Why might it be better for mosquito larvae to live in an old tin can of water instead of a swamp? If you have an aquarium, you might like to see whether your fish or snails will eat mosquito larvae.

There are even a few plants that kill larvae. One of these, the bladderwort, traps larvae in its leaves under the water. Other plants, such as duckweed, cover the surface of the water and prevent the adults from laying eggs.

Man, too, is an enemy of mosquito larvae. A common method of mosquito control in the past was to spread oil on the water in which the larvae lived. Now, poisons are used and are often sprayed from airplanes. Unfortunately, these poisons also kill other valuable living things, so their use must be carefully controlled. In most places, for example, the use of DDT is illegal except in emergencies.

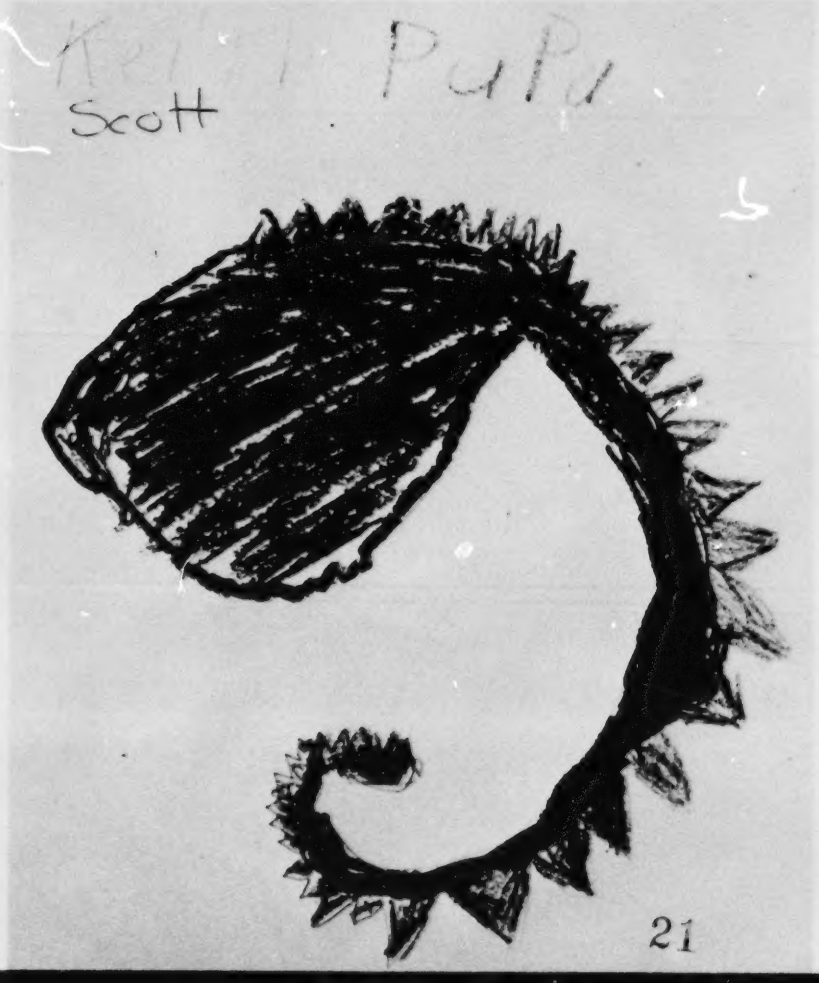
Sometimes fish are put into bodies of water to eat the larvae. Another method is to drain the water out of the wet areas where the larvae live or to fill these areas with dirt.

The larvae of one kind of mosquito can crawl along the ground. These larvae often live in the rainwater that is trapped in animal footprints. If a footprint dries up, the larvae leave and crawl as far as 30 inches to another water hole. Can your kind of mosquito larvae crawl at all?

Mosquito Pupae

After a few weeks, you will begin to notice black things that look like commas in the water with your wrigglers. These are wrigglers that have managed to live long enough and grow big enough to turn into pupae – the next stage of development. While they are pupae, the mosquitoes do not eat, so you do not need to give them food. How does a pupa differ from a larva? Does the pupa need air to live? Can you find any air holes in it? What keeps the pupa at the top of the water? Can a pupa move? Does it react to light and tapping the way a wriggler does? How long does the mosquito stay a pupa?

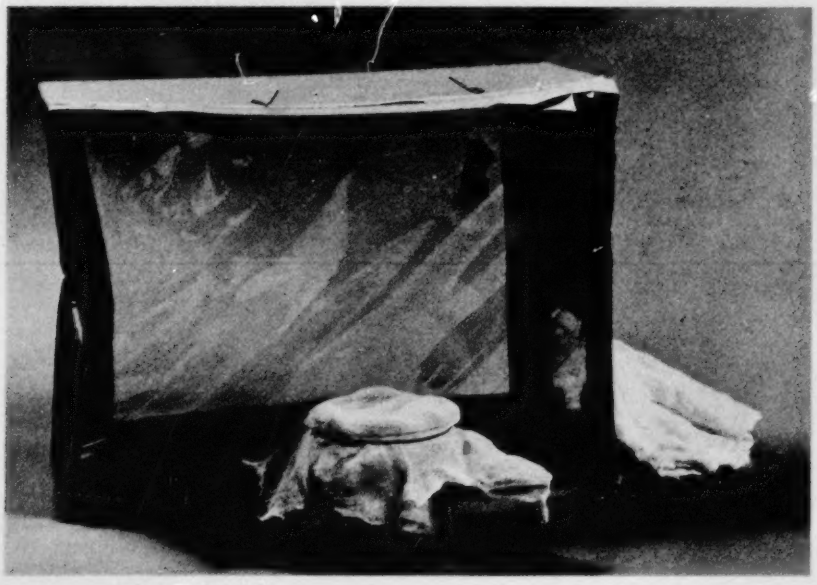
Hidden from view inside the covering of the pupa, the adult mosquito's legs and wings begin to form. When the mosquito is ready to come out, it pumps air into its stomach. This makes its body get larger and larger until the pupal covering breaks along a slit in back. The mosquito can then step out onto the surface of the water and walk away from the discarded pupal skin. Here it stands for about an hour, until its wings harden and it can fly away. If you're lucky, you will see a mosquito come out. Can you find a pupal skin? Look at it carefully. Can you see the opening where the adult mosquito came out?

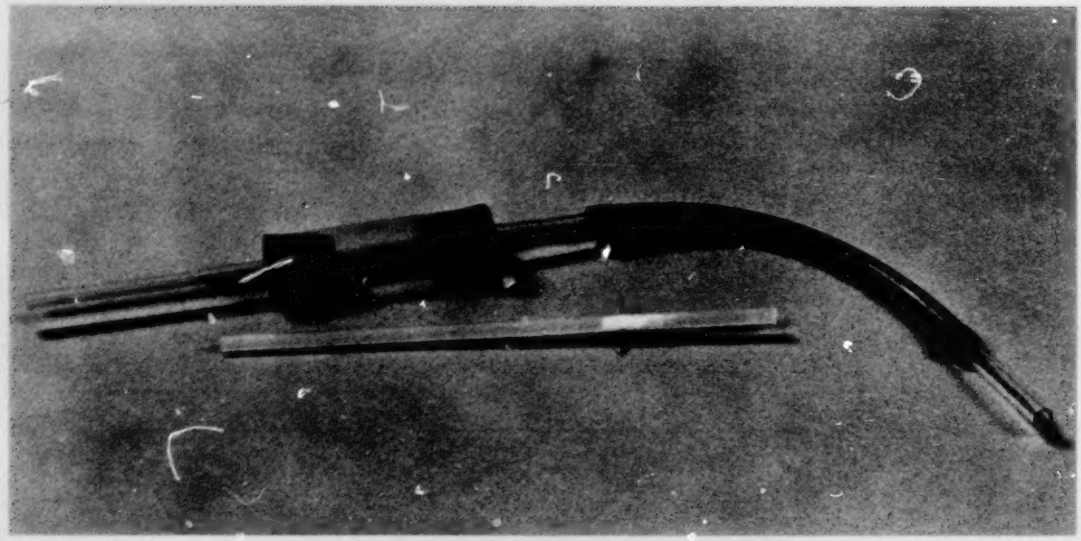


Adult Mosquitoes

Cages Unless you want mosquitoes flying around the room, you had better be sure your pupae are in a jar with a screen on top or in an open jar within a cage. Cages can be made of cardboard (cardboard boxes work well) and plastic sheeting. Plastic is better to use than netting, since it is easier to see through. It also holds in moisture, and mosquitoes survive better and are much more likely to lay eggs in a damp environment. With masking tape, attach cheesecloth or a nylon stocking to the hole in the side of the cage (as shown), so that you can get your hand in the cage without letting the mosquitoes out. If you leave the mosquitoes where they hatched—in a jar with screening on top—you should drain off the water when the adults have emerged, or they may drown. Just tip the jar slowly, and pour the water out through the screening.

Care of Adult Mosquitoes Both male and female mosquitoes drink plant juices from flowers and leaves. To keep your mosquitoes alive, you can feed them sugar water. Dissolve one teaspoon of sugar in three tablespoons of water. Soak a ball of absorbent cotton in this solution, and place it on top of the screening of the cage or suspend it on a string or a paper clip from the ceiling of the cage. Change the cotton ball at least every two days, so that the mosquitoes will have fresh food.





Instead of sugar water, you can soak raisins in water overnight and then suspend them in a little cheesecloth bag from the ceiling of the cage. These should be changed every few days also.

An aspirator is a useful tool when you move adult mosquitoes from one container to another or want to get a close look at a mosquito. You can make an aspirator out of rubber tubing, glass tubing, and cheesecloth or netting. A simpler one can be made out of a plastic straw, cheesecloth, and a straight pin.

To catch a mosquito with an aspirator, put the glass end near the mosquito and take a quick breath through the rubber tubing. You should be able to suck up the mosquito into the tube.

How many wings does a mosquito have? How many legs?
What do the mouth parts look like?
Can you find the eyes?

Telling Males from Females One of the best ways to tell male and female mosquitoes apart is by the two feelers (antennae) on the head. Like many other insects, mosquitoes use their antennae for hearing, as well as for feeling and tasting. The male's antennae are very bushy, while the female's have fewer hairs. How many males do you have? How many females?

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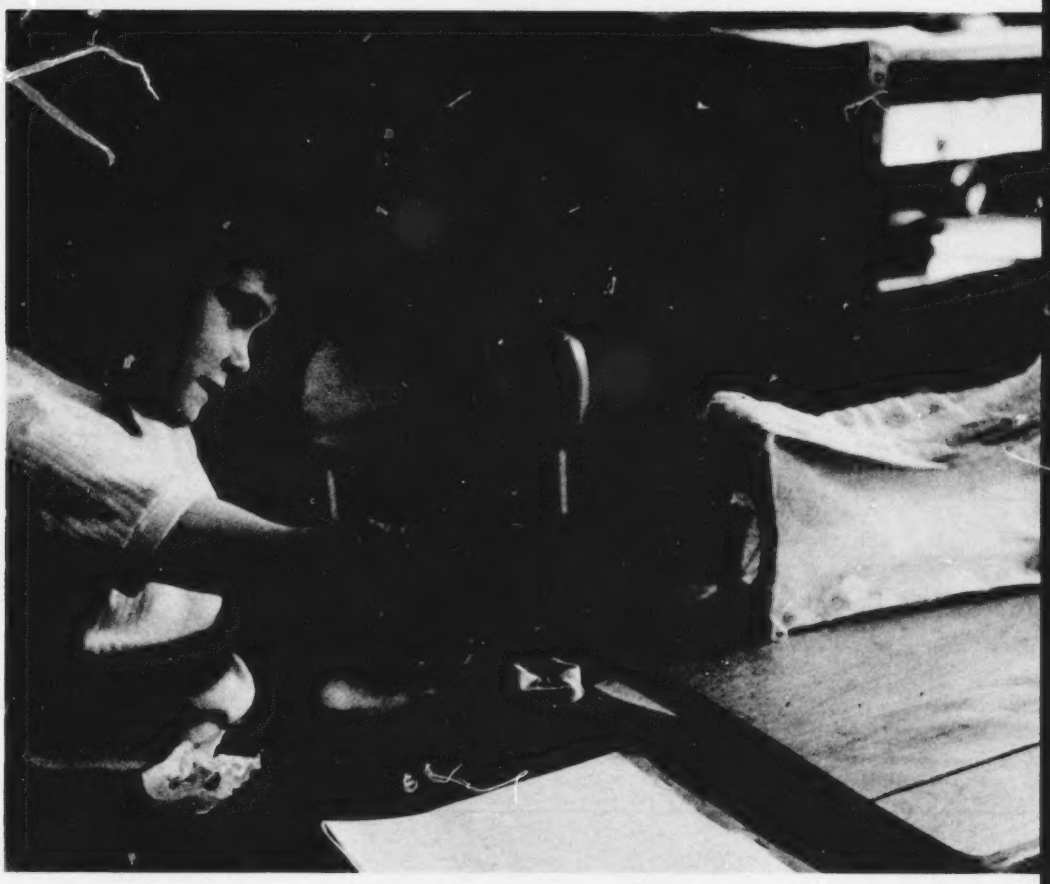
Mating and Egg Laying If you have several male and female mosquitoes in a cage together, some of them may mate and lay eggs. To do this, though, they will need two things—blood and an appropriate place to lay the eggs.

Only female mosquitoes bite. They need blood in order to be able to produce eggs. (*Aedes atropalpus* mosquitoes will, however, sometimes produce eggs without first drinking blood.) The easiest way to give your mosquitoes a blood meal is to put your arm in the cage or against the screening. Get in a comfortable position—it may take a while. If the mosquitoes don't bite, try again at a different time of day. Some mosquitoes bite only in the morning, others only at dusk.



If you are raising *Aedes atropalpus* mosquitoes, you may be able to get them to lay eggs. These mosquitoes lay their eggs on the surface of the water or on a damp object above the water, so if you want to try to get them to lay eggs, you should provide a paper cup partly filled with water and with a cylinder of paper toweling standing in it. Sometimes a bit of larval food (crushed dog biscuit) added to the water will encourage the mosquitoes to lay their eggs. The mosquitoes may lay their eggs on the toweling or on the surface of the water. If the eggs are laid on water, drain the water off almost completely with an eyedropper, or strain out the eggs on some paper toweling. Leave the eggs on the damp paper or in a closed container with some moisture for about two days. Then you can add water and food and see if they will hatch the way your first batch of eggs did. (See page 5.)

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The Life Cycle Completed

Mosquitoes normally die of old age after 10 to 40 days. Many are killed by animals before this. (One bat was found which had eaten 700 mosquitoes in one night.) Others are eaten by dragonflies, insect-eating birds, spiders, and frogs.

Adult male mosquitoes are also killed by cold weather. None can live outdoors through a cold winter. *Culex* and *Anopheles* females hibernate during the winter in warm, damp places, such as cellars, caves, tree holes, and barns. *Aedes* females die when winter comes, but they lay many eggs in the late fall. These are not harmed by cold. When the weather warms, the snow melts, water again fills the swamp, and the eggs start to hatch. The cycle of life begins again.

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Some Things Scientists Have Found Out About Mosquitoes

Mosquitoes and Sound

Several people in the past have noticed that male mosquitoes are attracted to certain sounds. One man found a large number of male mosquitoes clustered around a buzzing electric generator. Scientists have since experimented to find out why this is. They used tuning forks to make different sounds. Musicians use a tuning fork to sound a precise note. When a tuning fork is hit, it rings like a bell. Tuning forks of different lengths make different sounds.

The ringing tuning forks were held inside a mosquito cage. The mosquitoes swarmed around some tuning forks but not around others. They seemed to be attracted only by certain sounds. Just as with the generator, all the mosquitoes which flew to the ringing forks were males. Scientists then wondered why only male mosquitoes reacted to these sounds. (If you can get some tuning forks, you can try this experiment. You might try other sounds, too. Does a xylophone work? Does a violin? Does a bell?)

Mosquitoes usually mate while they are flying. How do they find each other in the air? Scientists thought that perhaps the males don't see the females but are attracted to the sound of the females' wings, just as they are to the ringing of the tuning forks.

You have heard the buzzing noise which a mosquito makes as it flies around your head. The buzzing you hear comes from the flapping of the mosquito's wings. They go up and down very fast—about 300 or 400 times every second. Scientists found that the sound made by the moving wings of female mosquitoes is about the same as the sound of the tuning forks which attracted the male mosquitoes. It certainly seemed as if males located a flying female by the sound of her beating wings.

To try to prove this, the investigators attached a female mosquito to a stick (without injuring her) and put her into a cage with male mosquitoes. Nothing happened. Then the female began to flap her wings as she does when flying. Suddenly, many males flew around her. When she stopped flapping her wings, the males went away.

How close to your ear does a mosquito have to be before you can hear it? From how far away can males hear flying females? How could you find out?

Do you think it really is the sound of a female's wings which attracts the males? Maybe male mosquitoes follow an odor which is given off only when the female flies. Perhaps a female mosquito can be seen more easily when her wings are flapping. Can you think of some other possible explanations?

If a male mosquito is attached to a stick, other males are not attracted, even when his wings are moving. Why is this? Could it be that the sound made by a male's wings is different from the sound made by a female's wings? If a male mosquito's wings are clipped a tiny bit, however, other males *are* attracted to him. What do you suppose clipping does to the sound?

Biting

If you can manage it, watch a mosquito while she bites you. How does she get her mouth parts into your skin? Does her abdomen swell? Can you see blood inside her? If you let the mosquito drink her fill, she will probably fly off weighing more than twice as much as she did before. Think how much more milk you would have to drink to weigh twice as much as you do now. Even with a big load of blood, the female mosquito is still able to fly. She will not need more blood for three or four days. It takes this long for her to digest one blood meal.

A mosquito's mouth is a long needle-shaped projection, called a proboscis. When this is opened up under a microscope, it is found to be made of several parts. There are four sharp bristles, two thin tubes, and an outer covering like a sleeve.

In order to find out how a mosquito uses these different parts of its proboscis, a biologist held the foot of a live frog under a microscope. Mosquitoes of a kind that likes frog blood were put near the foot, and finally one began to bite. The biologist saw the sharp bristles of the mosquito's proboscis being stuck into the skin. On the end of each bristle were hooks which helped hold the bristle in the hole that it was making. Every time a bristle was jabbed down, it went deeper. Soon the bristles had cut a hole through the skin and down into a little blood vessel. Then the mosquito began to suck the frog's blood up with one tube and to spit saliva down the other tube. Scientists think the saliva helps to keep the blood from clotting.

If you're willing to let a mosquito bite you, you can find out a few things about mosquito bites. Do they swell and itch more if you let the mosquito stay on until she's finished or if you chase her away right after she starts sucking? Does a mosquito bite itch and swell less if you don't scratch it?

What Animals Do Mosquitoes Prefer to Bite? Two scientists wanted to find out which animals one type of mosquito liked best to bite. They put a cow, a pig, a dog, a cat, a chicken, and even a man in a room and released mosquitoes in it. Later, the mosquitoes were caught, and the blood which each mosquito had eaten was examined. Chemicals were used to test the blood, to see which animal it had come from. The chart on page 22 shows how many times the animals were bitten during the experiment.

Why do you think cows and goats were bitten more than dogs and chickens?

Animal	*Number of times bitten*
cow	238
goat	125
pig	69
man	24
cat	18
dog	17
chicken	9

How Does a Mosquito Find You? Can you think of some ways in which a mosquito might find you? Perhaps you think she follows your smell. Some mosquitoes do respond to odors—their sense of smell, like their sense of hearing, is located on their antennae—but experiments have shown that smelling doesn't help a mosquito much in finding you.

Perhaps the mosquito sees you. Certain types of mosquitoes do seem to like dark colors better than light ones. Black guinea pigs and white guinea pigs were put into a cage of mosquitoes. Many more black guinea pigs were bitten than white ones. In another experiment, a person wore colored gloves—one darker than the other. Mosquitoes bit through the darker glove more often.

On the other hand, dark objects absorb more heat than light-colored ones. Perhaps the mosquitoes bite the dark-colored guinea pigs and gloves more often because they are warmer than the light-colored ones.

If someone puts his bare arm in a mosquito cage underneath a piece of glass, the mosquitoes at first do nothing. After a few minutes, however, they begin to try to bite the glass. Why don't they do this right away? One scientist thought that the mosquitoes are attracted to the glass as it becomes warmed by the arm. He made an "artificial arm." This was a glass tube through which hot water flowed. When the tube got warm, mosquitoes tried to bite it.

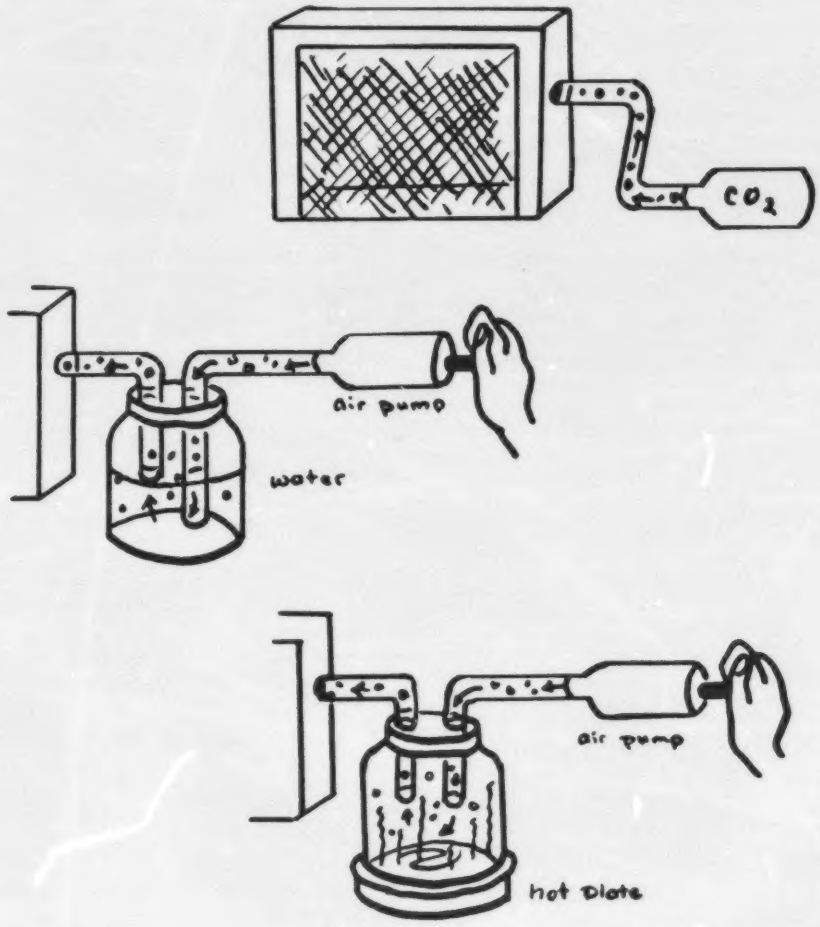
The warmth of your body may help mosquitoes find you, but there are other things, too. Sometimes mosquitoes bite your head more than other parts of your body. Mosquitoes in cages often won't bite a person's arm if he puts it in, but when he puts his head in, they cluster around and bite. What is there about the head that attracts mosquitoes?

When someone breathes into a glass tube containing mosquitoes, they try to bite the side of the tube. What do mosquitoes notice about the

breath – the temperature, the moisture, the carbon dioxide, or something else? What kind of experiment could you do to find out?

Here is one experiment that was done. Some warm air was blown into a cage of mosquitoes. Then carbon dioxide was blown in. Finally, moist air was blown in. Only a few mosquitoes went to the warm air and the moist air. Many more were attracted to the carbon dioxide.

Some of the things which have been described may help mosquitoes find you when they are only a few feet away from you. How are they able to get this close when they start out far away? It may be that they come upon you just by chance. Some scientists think that some types of mosquitoes might be attracted to dark objects and moving shapes.



Mosquito Flight

Mosquitoes can travel quite fast. At full speed, some fly as fast as 45 feet in a second – 30 miles an hour.

Mosquitoes don't usually fly very high. This is why no screens are needed on windows near the top of a tall building. Why do you think mosquitoes usually stay close to the ground?

Several experiments have been done to find out how high mosquitoes do fly. Mosquitoes are attracted to lights, so lights can be used to trap them at night. In one experiment, light traps were placed on the ground and at different heights on a tower 100 feet high. Many more mosquitoes were caught close to the ground. There were usually not any mosquitoes in the traps above 75 feet.

An airplane was used in another experiment to catch insects. Special insect traps were mounted on the wings of a plane. Inside the trap were many screens covered with sticky stuff. Any insect which hit a screen would stick to it. The screens were exposed, one at a time, at different heights.

Thousands of insects of all kinds were caught. Eleven mosquitoes were trapped at about 1,000 feet. One was even found at 5,000 feet. There were even many spiders found in the traps on the airplane. How do you think they got so high?

How Far Do Mosquitoes Fly? Some scientists wanted to find out how far mosquitoes fly. They marked a lot of mosquitoes, so that they would know them when they saw them again. They did this by blowing powder on mosquitoes in a box. The powder stuck to the mosquitoes but did not harm them. Altogether 54,950 mosquitoes were marked and let go.

Live calves were used as bait to recapture the mosquitoes. Calves were tied in small huts with thatched roofs. Hanging inside were pieces of black cloth in which the mosquitoes could hide. The calf that was tied in each hut attracted mosquitoes during the night. When daylight came, the mosquitoes hid in the cloth and could be caught. Eighty such traps were placed in circles as far as a mile from where the mosquitoes were released.

The investigation took a long time and a lot of work. Altogether 207,800 mosquitoes were caught. Among all these, only 601 were marked with the

powder. Most of these were found in traps ½ mile or less from the place where they were let go. A few marked mosquitoes were found in a village 1½ miles away. What do you think happened to all the others that were marked?

When Do Mosquitoes Fly? Most types of mosquitoes fly around only at night. If they came out during the day, they would be dried out and perhaps killed by the heat of the sun. In the daytime, they hide in the grass, under bridges, and in houses and barns. Some mosquitoes do move around during the day in woods where it is cool and damp. Can you find out how much heat a mosquito can stand? Can it survive higher temperatures in a damp place than in a dry one?

Different Kinds of Mosquitoes and the Diseases They Spread

Aedes is one of the three main types of mosquitoes. They almost always live close to where people live. Their eggs are the black-speck kind. One kind of *Aedes*, the *Aedes aegypti* mosquito, is responsible for transmitting yellow fever. This is a disease caused by a virus which lives in the blood. If a mosquito bites someone who has yellow fever, it carries away some of the viruses in the blood which it takes. The viruses soon die in the stomachs of most types of mosquitoes, but in *Aedes aegypti*, the disease-causing viruses continue to live. No one knows why they live inside just this one kind of mosquito. Sometimes an *Aedes aegypti* mosquito which has bitten someone with yellow fever later bites a healthy person. The viruses which cause yellow fever enter the healthy person's blood in the saliva which the mosquito spits out. They may then grow in number until the person becomes ill with yellow fever. An *Aedes aegypti* mosquito can give you yellow fever only if it has bitten someone else with the disease, and few people in the United States now have yellow fever.

Anopheles is another type of mosquito. You can recognize an *Anopheles* mosquito by the way it bites. Instead of keeping its body horizontal as other mosquitoes do, it bends down so that its back part points up in the air. *Anopheles* eggs are different from other mosquito eggs, too, in that each egg has two tiny floats.

There are approximately 2,000 kinds of *Anopheles* mosquitoes. About forty of these carry malaria, a disease caused by tiny animals which live

in the blood. Just as with the *Aedes* and yellow fever, the *Anopheles* can give you malaria only if it has already bitten someone else who has the disease, and malaria isn't common in the United States anymore either.

The most common type of mosquitoes is the *Culex*, or house mosquito. *Culex* eggs are the ones which float on the water as an "egg raft." The larva, pupa, and adult of *Culex* are also different from *Aedes*. If you can get both types of larvae, you may be able to compare them.

You can find out more about the different kinds of mosquitoes in an encyclopedia. Maybe you can get some other books which tell how scientists discovered that mosquitoes carry yellow fever and malaria.